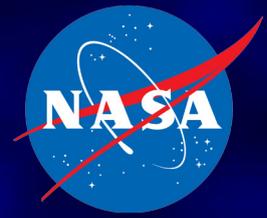


National Aeronautics and Space Administration



gooddardview

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Terra Satellite Sees Intense Fires and Smoke Over Western Russia

By Holli Riebeek

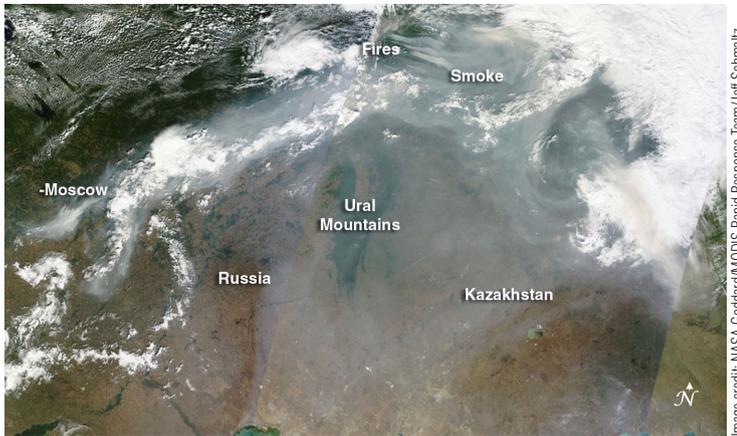
Though a plume of smoke still stretched across hundreds of kilometers, conditions in central Russia appeared to be much better on August 12, 2010. The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's *Terra* satellite detected two clusters of intense fires when it acquired a photo-like image.

The NASA image is a composite of three separate satellite images. The MODIS Rapid Response Team at NASA's Goddard Space Flight Center created the composite image, and diagonal lines mark the seams between each image.

The first cluster of fires is southeast of Moscow. Though the fires were producing thick smoke when MODIS captured the image on August 12, the smoke was blowing away from the city. Moscow appeared to have relatively smoke-free skies compared to previous days.

The second cluster of fires is in the Ural Mountains. The smoke from these fires extends south into Kazakhstan. Apart from the thick plume of smoke that seems to connect the two fire regions, a lighter pall of smoke hangs over southern Russia and northern Kazakhstan.

For more images from the MODIS Rapid Response Team, visit:
<http://rapidfire.sci.gsfc.nasa.gov>. ■



Caption: The MODIS instrument on NASA's *Terra* satellite detected two clusters of intense fires when it acquired a photo-like image.

Image credit: NASA Goddard/MODIS Rapid Response Team/Jeff Schmaltz

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Cover caption: Image from *Fermi*'s Large Area Telescope as it detects gamma rays from Nova Cygni.

Photo credit: NASA/Goddard/DOE/*Fermi* LAT Collaboration

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Fermi Detects ‘Shocking’ Surprise from Supernova’s Little Cousin

By Francis Reddy

Astronomers using NASA’s *Fermi Gamma-ray Space Telescope* have detected gamma-rays from a nova for the first time, a finding that stunned observers and theorists alike. The discovery overturns the notion that nova explosions lack the power to emit such high-energy radiation.

A nova is a sudden, short-lived brightening of an otherwise inconspicuous star. The outburst occurs when a white dwarf in a binary system erupts in an enormous thermonuclear explosion.

“In human terms, this was an immensely powerful eruption, equivalent to about 1,000 times the energy emitted by the Sun every year,” said Elizabeth Hays, a *Fermi* Deputy Project Scientist at Goddard Space Flight Center. “But compared to other cosmic events *Fermi* sees, it was quite modest.”

Gamma-rays are the most energetic form of light, and *Fermi*’s Large Area Telescope (LAT) detected the nova for 15 days. The emission arose as a million-mile-per-hour shockwave raced from the site of the explosion.

The story opened in Japan during the predawn hours of March 11, when amateur astronomers Koichi Nishiyama and Fujio Kabashima imaged a dramatic change in the brightness of a star in the constellation Cygnus. They realized that the star, known as V407 Cyg, was 10 times brighter than in an image they had taken three days earlier.

On March 13, Goddard’s Davide Donato was on duty as the LAT “flare advocate,” a scientist who monitors the daily data downloads for sources of potential interest, when he noticed a significant detection in Cygnus.

“This region is close to the galactic plane, which packs together many types of gamma-ray sources—pulsars, supernova remnants, and others in our own galaxy, plus active galaxies beyond them,” Donato said. “If the nova had occurred elsewhere in the sky, figuring out the connection would have been easier.”

On March 17, the researchers decided to obtain a “target-of-opportunity” observation using NASA’s *Swift* satellite—only to find that *Swift* was already observing the same spot.

“At that point, I knew *Swift* was targeting V407 Cyg, but I didn’t know why,” said Teddy Cheung, an astrophysicist at the Naval Research Laboratory (NRL) in Washington, D.C., and the lead author of the study. Examining the *Swift* data, Cheung saw no additional X-ray sources that could account for what *Fermi*’s LAT was seeing. V407 Cyg had to be it.

Half an hour later, Cheung learned from other members of the LAT team that the system had undergone a nova outburst, which was the reason the *Swift* observations had been triggered. “When we looked closer, we found that the LAT had detected the first gamma-rays at about the same time as the nova’s discovery,” he said.

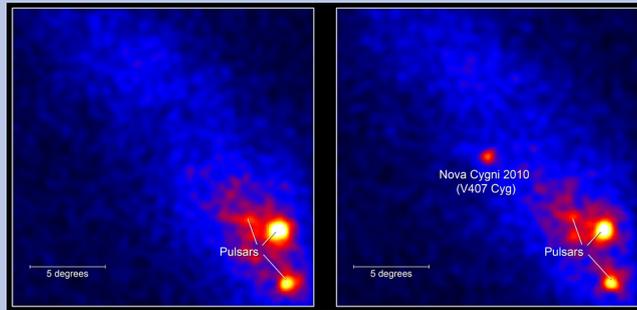


Photo credit: NASA/DOE/Fermi LAT Collaboration

Caption: Fermi’s Large Area Telescope saw no sign of a nova in 19 days of data prior to March 10 (left), but the eruption is obvious in data from the following 19 days (right).

V407 Cyg lies 9,000 light-years away. The system is a so-called symbiotic binary containing a compact white dwarf and a red giant star about 500 times the size of the Sun.

“The red giant is so swollen that its outermost atmosphere is just leaking away into space,” said Adam Hill at Joseph Fourier University in Grenoble, France. The phenomenon is similar to the solar wind produced by the Sun, but the flow is much stronger.

The white dwarf intercepts and captures some of this gas, which accumulates on its surface. As the gas piles on for decades to centuries, it eventually becomes hot and dense enough to fuse into helium. This energy-producing process triggers a runaway reaction that explodes the accumulated gas. The white dwarf, however, remains intact.

The blast created a hot, dense expanding shell called a “shock front,” composed of high-speed particles, ionized gas, and magnetic fields. According to an early spectrum obtained by Christian Buil at Castanet Tolosan Observatory, France, the nova’s shock wave expanded at 7 million miles per hour—or nearly 1 percent the speed of light.

The magnetic fields trapped particles within the shell and whipped them up to tremendous energies. Before they could escape, the particles had reached velocities near the speed of light. Scientists say that the gamma rays likely resulted when these accelerated particles smashed into the red giant’s wind.

“We know that the remnants of much more powerful supernova explosions can trap and accelerate particles like this, but no one suspected that the magnetic fields in novae were strong enough to do it as well,” said NRL’s Soebur Razzaque.

Kent Wood at NRL compares astronomical studies of supernova remnants to looking at static images in a photo album. “It takes thousands of years for supernova remnants to evolve, but with this nova we’ve watched the same kinds of changes over just a few days,” he said. “We’ve gone from a photo album to a time-lapse movie.” ■

NASA Technology Helps Find and Rescue 16-Year-Old Sailor

By Christina Coleman

Sixteen-year-old Abby Sunderland is home again after attempting to sail around the world alone. But in early June, Abby was floating helplessly in the Indian Ocean about 2,000 miles from Madagascar, her 40-foot vessel, *Wild Eyes*, damaged in an aggressive storm.

Her harrowing ordeal began on June 10, when 30-foot swells knocked down her mast and destroyed two satellite radio antennas, cutting off her most reliable voice communication capability and only means of talking directly with her family and others on land. Her VHF long-range radio had also been destroyed and only one of two Emergency Position Indicating Radio Beacons (EPIRB) used by sailors, pilots, and hikers to alert rescuers of a distress was functioning. Fortunately, Abby's boat stayed afloat, but just barely in the choppy sea.



Caption: Abby Sunderland sets off on her eventful trip.

In a powerful display of NASA spin-off technology, however, Abby's life was changed with a small yellow device the size of a BlackBerry™. Abby was carrying a third beacon—a MicroPLB Type GXL handheld device—developed under a NASA Small Business Innovation Research (SBIR) program award to Microwave Monolithics Inc. (MMInc.) in Simi Valley, Calif. Company President David Ch'en had given Abby the device before she tried to break the record of sailing non-stop around the world, held by her older brother.

Unbeknownst to most of the media, NASA had provided Microwave Monolithics with the specifications to design the beacon, which relayed her distress signal to the Search and Rescue Satellite-Aided Tracking (SARSAT) satellite, 22,500 miles away in space. When Abby flipped the top off the beacon, the satellite, equipped with NASA-developed repeater technology, then relayed the signal to the U.S. via the international satellite-aided search and rescue network now comprised of 40 participating nations.

"Without NASA technology, she may have lost her life. This case was more interesting than most because we contributed to every aspect of it," said NASA Search and Rescue Mission Manager Dave Affens, who works at NASA's Goddard Space Flight Center in Greenbelt, Md. "We developed the concept of detecting distress signals by the satellite, relaying it to ground

stations where the locations were calculated. We then launched the distress detection device on a NOAA (National Oceanic and Atmospheric Administration) weather satellite, tested the concept, and approved the system for operational use," he added.

Only eight minutes after manually activating the beacon, which was tied to her waist, the U.S. Coast Guard's Pacific Area Command in Alameda, California, was able to contact her worried parents using information she had provided when she registered her beacon with NOAA, which operates the U.S. component of the search and rescue system. Less than an hour later, two of the NOAA weather satellites, launched by NASA and also equipped with repeater technology, pinpointed her location. An Australian Airbus 330 flew 11 hours to Abby's location and communicated with her through a VHF walkie-talkie capable of communicating a few miles, the only radio left after the ordeal. Ultimately, a French fishing vessel, which was 400 miles from her location when the distress signal was detected, was directed to her location to perform the rescue.

"Our motto here is 'taking the search out of search and rescue,' so we want to reduce that part to a minimum," Affens said. "In this case, we've got a really great spin-off technology, because we saved a 16-year-old girl. Everybody can identify with saving a life."

"That's the beauty of this program," he continued. In the 30 years since the system began operations, it has saved more than 28,000 lives.

In the near future, Affens and his team are developing new technology to further take the "search out of search and rescue" with new technology that is sure to increase the number of rescues in which SARSAT has assisted.

Engineers at Goddard, along with NOAA, the Coast Guard, and the Air Force are developing a new search and rescue system that will detect and locate distress signals from beacons in less than five minutes. The current system, which places repeaters on weather satellites, can actually take up to an hour or more to locate the distress signal depending on the position of the satellite.

The Distress Alerting Satellite System, or DASS, will be more efficient because the repeater technology will be placed on the Global Positioning System (GPS), instead of NOAA weather satellites. Using the constellation of 24 GPS spacecraft operating in mid-Earth orbit, "we would be able to identify distress signals faster and with a greater level of precision," Affens said.

Currently, 10 of the 20 GPS satellites are carrying proof-of-concept DASS equipment. The system is expected to become operational after 2015.

For more on Abby's journey, visit: <http://www.abbysunderland.org>. ■

Interstellar Boundary Explorer Finds Discoveries Close to Home

By J. Kelly Beatty

Imagine floating 35,000 miles above the Sunny side of Earth. Our home planet gleams below, a majestic whorl of color and texture. All seems calm around you. With no satellites or space debris to dodge, you can just relax and enjoy the black emptiness of space. But looks can be deceiving.

In reality, you've unknowingly jumped into the place in space where a supersonic "wind" of charged particles from the Sun crashes head-on into the protective magnetic bubble that surrounds our planet. Traveling at a million miles per hour, the solar wind's protons and electrons sense Earth's magnetosphere too late to flow smoothly around it. Instead, they're shocked, heated, and slowed almost to a stop as they pile up along its outer boundary, the magnetopause, before getting diverted sideways.

Physicists have had a general sense of these dynamic goings-on for decades. It wasn't until the *Interstellar Boundary Explorer* (IBEX), however, that they've been able to see what the human eye cannot: the first-ever images of this electromagnetic crash scene. They can now witness how some of the solar wind's charged particles are being neutralized by gas escaping from Earth's atmosphere.

IBEX wasn't designed to keep tabs on Earth's magnetosphere. Its job is to map interactions occurring far beyond the planets, 8–10 billion miles away, where the Sun's heliosphere, meets interstellar space.

Only two spacecraft, *Voyagers 1* and *2*, have ventured far enough to probe this region directly. IBEX, which travels in a looping, 8-day-long orbit around Earth, stays much closer to home, but it carries a pair of detectors that can observe the interaction region from afar.

When fast-moving protons in the solar wind reach the edge of the heliosphere, they sometimes grab electrons from the slower-moving interstellar atoms around them. This charge exchange creates electrically neutral hydrogen atoms that are no longer controlled by magnetic fields. Suddenly, they're free to go wherever they want—and because they're still moving fast, they quickly zip away from the interstellar boundary in all directions.

Some of these "energetic neutral atoms," or ENAs, zip past Earth, where they're recorded by IBEX. Its two detectors record the number and energy of atoms arriving from small spots of sky about the size of a tennis ball held at arm's length. Because its spin axis always points at the Sun, the spacecraft slowly turns throughout Earth's orbit and its detectors scan overlapping strips that create a complete 360 degrees map every six months.

Because IBEX is orbiting Earth, it also has a front-row seat for observing the chaotic pileup of solar-wind particles occurring along the "nose" of Earth's magnetopause, about 35,000 miles out. ENAs are created there too, as solar-wind protons wrest electrons from hydrogen atoms in the exosphere.

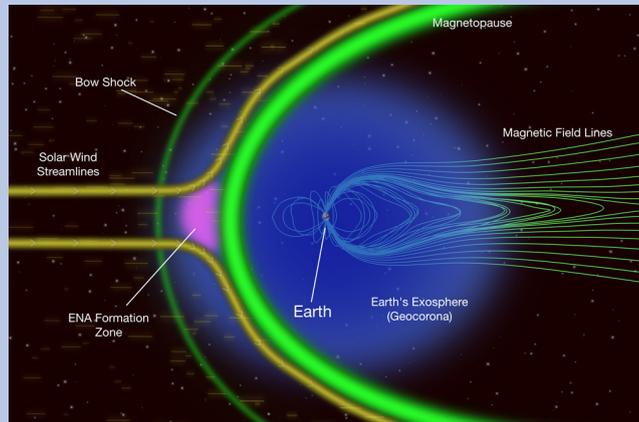


Image credit: NASA/Goddard

Caption: IBEX found that ENAs are coming from a region just outside Earth's magnetopause where nearly stationary protons from the solar wind interact with the tenuous cloud of hydrogen atoms in Earth's exosphere.

Now, thanks to IBEX, we know just how tenuous the outer exosphere really is. "Where the interaction is strongest, there are only about eight hydrogen atoms per cubic centimeter," explains Stephen A. Fuselier, the Lockheed Martin Space Systems researcher who led the mapping effort. His team's results appear in the July 8 issue of *Geophysical Research Letters*.

Since its launch, IBEX has also scanned another nearby world, with surprising results. The Moon has no atmosphere or magnetosphere, so the solar wind slams unimpeded into its desolate surface. Most of those particles get absorbed by lunar dust. In fact, space visionaries wonder if the Moon's surface has captured enough helium-3, an isotope present in tiny amounts in the Sun's outflow, to serve as a fuel for future explorers.

Yet cosmic chemists have long thought that some solar wind protons must be bouncing off the lunar surface, becoming ENAs through charge exchange as they do. So does the Moon glow in IBEX's scans? Indeed it does, says David J. McComas of Southwest Research Institute in San Antonio, Texas, who serves as the mission's Principal Investigator.

In a report published last year in *Geophysical Research Letters*, McComas and other researchers conclude that about 10 percent of the solar wind particles striking the Moon escape to space as ENAs detectable by IBEX. That amounts to roughly 150 tons of recycled hydrogen atoms per year.

Meanwhile, the squat, eight-sided spacecraft continues its primary task of mapping the interactions between the outermost heliosphere and the interstellar medium that lies beyond. McComas and his team are especially eager to learn more about the mysterious and unexpected "ribbon" of ENAs that turned up in the spacecraft's initial all-sky map.

At Goddard, IBEX Mission Scientist Robert MacDowall says the spacecraft should be able to continue its observations through at least 2012. "We weren't sure those heliospheric interactions would vary with time, but they do," he explains, "and it's great that IBEX will be able to record them for years to come." ■

OutsideGoddard: All Fired Up

By Elizabeth M. Jarrell

Most mothers instruct their children never to play with fire. Gerald J. “Tiki” Tiqui’s mother, however, simply says, “It’s your life. If you want to get burned, go ahead.”

Tiki, an Equal Opportunity Specialist in Goddard’s Equal Opportunity Program Office, is a professional Polynesian dancer specializing in the Samoan Fire Knife dance. For the past 20 years, he has been performing with a local entertainment group called HOALOHA, which is Hawaiian for “friends.”



Caption: Gerald “Tiki” Tiqui at the 2009 Hawaii State Inaugural Ball.

Tiki was born and raised in Hawaii and is a mixture of Hawaiian, Filipino, Chinese, and Spanish. Tiki learned Polynesian dancing at the age of nine as part of the Hawaiian cultural heritage that includes a mixture of Hawaiian, Samoan, Tahitian, and Maori cultures. Tiki and his entire family danced with a *halau*, a group that performs for events including competitions. Around 1989, the *kumuhula* or teacher of his current halau asked him if he would like their departing fire knife dancer to train him as a replacement. Tiki’s reaction was, “Sure. Fire knife dancing is fascinating! When you see something like that, you know that not everyone can do it.” Tiki was then in his 20s.

Today, fire knife dance instruction begins when the student is only four or five years old and parental consent is required. Tiki further explains that “it was once forbidden for females to do fire knife dancing as part of the culture. Today you will see females doing fire knife dancing.” According to Tiki, “It takes great athletic skills, strength, and endurance to perform this dance and a little bit of a crazy mind set to want to play with fire.” Tiki was crazy enough to undertake this challenge and successful enough to perform on stage.

For obvious reasons, fire knife dancing can only be learned from another professional fire knife dancer. The initial instruction generally takes six months to one year, but Tiki was rushed through in only two and one half months because their fire knife dancer was leaving. He only had enough time to learn the basic moves.

Since then, he has taken master classes from the top two fire knife dancers in the world. According to Tiki, “You have to prove to these top instructors that you are worthy of being taught special skills that they will only teach to a select few.” Tiki has become a teacher as well. Fire knife dancing has a unique rite of passage. As Tiki explains, “To be a true fire knife dancer, you have to do the entire routine blindfolded before you may use fire. This is because you always have to be aware of where your fire is.”

The fire knife dance is based on the knife dance, an ancient, traditional Samoan ceremonial dance that dates back to the 1800s. At that time, Samoan weapons consisted of wooden knives and swords and the music was rhythmic chants and songs. Today, metal has replaced wood. Around 1940, fire was added to the knife dance and the music changed to pulsating drumming on wooden drum logs, bass drums, and even tin cans to further increase the excitement level.

Tiki notes that “a ceremonial dance means dancing to the Chief or the Court, which only happens during important ceremonies.” Even unlit, the fire knife, or *Siva Afi*, is rather formidable. Tiki made his fire knife customized to his arm length so his fire knife is three feet long. One end has a knife fourteen inches long and two inches wide. The other end has a ball four inches in diameter. Both ends are wrapped in fire-resistant material that he sets on fire using Coleman lamp fuel to produce a cooler and cleaner flame than would gasoline.



Caption: Tiki announces his presence at Celebrate Goddard.

OutsideGoddard: All Fired Up

Continued from Page 10



Caption: Tiki wows the crowd.

Although he is very careful, Tiki admits that “Every time I dance, my arm and chest hair get burned.” The key to minimizing burns is to maintain a steady tempo when moving. Tiki treats his burns with silverdene, an ointment used for burn victims, or aloe creams depending on their severity. Tiki’s position is that “To be a true fire knife dancer, you will get burned. You cannot be afraid of the fire.”

The fire knife dance requires a highly specific sense of place, focus, and frame of mind. As for place, the routine must fit each particular space. In addition, for outside performances, the direction of the wind is critical in order to know which direction to face. Tiki further explains the concept of a sense of space in that “You need to be focused on your surroundings and the people around you. You must always know your place within the space.”

Regarding focus and frame of mind, Tiki instructs that, “It takes a lot of training to focus on one thing at a time and to block any negativity, which is a distraction. Of course I always have a smile on my face when performing the fire knife dance. I even smile bigger when I burn myself because then I start gritting my teeth. I take this very seriously to make sure that I do not harm anyone. Then I just focus on the routine I’m going to do within that space.”

In addition to practicing his actual routine, Tiki must be physically prepared. He works on building his strength and flexibility. According to him, “To do something like this, you have to be pretty athletic and flexible. I do a lot of exercising and stretching. I must be stretched to do my routine.”

Tiki toughens his skin in any area which will touch the fire knife flame. For example, he walks barefoot a lot to build calluses on his feet. During his routine, he lies on his back, puts his feet in the air, and places the burning fire knife on his feet. He puts the fire knife on the ball of his foot because it is the toughest part of the foot. By the way, he has never walked on fire. Tiki also touches the flaming fire knife with his tongue. As he explains, “The first time I stuck fire on my tongue, I wound up getting a lot of burn blisters. Today I have no problems. It’s like building calluses on your hands.”

Tiki also prepares mentally before doing his routine. He explains that “Before I do my routine, I say a chant three times for protection. Every fire knife dancer has his own special chant.” Tiki relies on a Buddhist chant spoken in Japanese but usually written in ancient Chinese Sanskrit which is “NAM MYOHO RENGE KYO.” Loosely translated, his chant means “Devotion to the mystic law through cause and effect and by sound and rhythm.”

Each fire knife dancer has a signature move. Tiki explains his as follows: “I roll on the ground on top of the burning knife. As long as you keep moving, you won’t get burned.” His routine lasts about five minutes. His costume is a Samoan loincloth with rings of artificial fern leaves around his wrists, ankles, and head.

Tiki wants his audience “to drop their jaws and ask, ‘Is that guy crazy?’” As for himself, Tiki describes his reaction as follows: “It’s thrilling. It’s a fast-paced routine. Your adrenaline is pumping. A lot of fire knife dancers only do the fire knife dance and no other dances. I do other dances too.” Most of all, Tiki wants his audience “to always remember the fire knife dance and all the other Polynesian dances.” For Tiki, the fire knife and other dances are not a sport; rather, these dances are his way of sharing his ancient culture.

Tiki offers the following advice to anyone who wishes to learn Samoan fire knife dancing: “First, you have to respect the fire. Second, you cannot be afraid of the fire. Third, be happy in what you do because if you’re happy doing this, things will go your way. When I’m having a bad day and do the fire knife dance, I can get careless and get hurt.”

Any aspiring fire knife dancers should be pleased that Tiki does not charge for giving lessons. His open-door policy is that “If you want to learn, I’ll teach you if you feed me.” Just don’t tell your mother. ■

New Deputy Brings International Education Experience

By Dewayne Washington

Exploration for a different challenge and new opportunities has landed Dean Aaron Kern a new position as Deputy Director for the Office of Education at Goddard. He arrives with a wealth of national and international teaching experience he hopes to share with others.

Kern admits being excited about his new position because of a positive NASA experience over 20 years ago. "My first exposure to NASA was part of an international group of teachers attending a two-week training project at the Johnson Space Center. At the end I remember saying this was a great opportunity for teachers to receive training from the experts and lots of great resources for the classroom," he said.



Caption: Goddard's new Deputy Director for the Office of Education, Dean Kern.

In college Kern admits he was a typical student, altering his direction of study several times before settling on a dual major in elementary and special education. Ultimately, he had to decide between a course in classroom design or neuropsychology. "Neuropsychology and disabilities was much more interesting and led to my interest in learning more about how to work with students with disabilities in the classroom."

After receiving a bachelor's degree from Northern Arizona University (NAU) Kern began his teaching career in Phoenix, Arizona. "I've been a special and elementary education teacher at all levels of K-12 and even taught music at one point in my career" he said. Along the way, Kern obtained a Master of Arts degree in education administration from NAU, and continued doctoral studies at the University of Colorado at Denver.

Kern spent 10 years teaching in four different countries working in international American and British sponsored schools before returning to the U.S. He worked for several more years in the emerging education school choice effort known as charter schools at the local and state levels before joining the U.S. Department of Education in 2002 as Director of the Charter Schools Program. "I became interested in the charter school programs from a civil rights and social perspective where you are addressing a critical issue and the achievement challenges for kids because of their zip code, ethnicity, and/or race," Kern said. "I see the NASA experience as another opportunity to use my educational background to have a positive influence on student learning."

As Deputy Director, Kern will oversee Goddard's educational programs. "We are indeed fortunate to have Dean join the Goddard staff," said Dr. Robert Gabrys, director of Goddard's Office of Education. "His background in education at the school, state, and government levels provides us with a depth of education expertise that will serve both the Center and Headquarters (NASA) well."

According to Kern, NASA's Summer of Innovation program is definitely a part of the national conversation. "It brings to the forefront more visibility for STEM (Science, Technology, Engineering, and Mathematics), which is becoming part of the mainstream conversation when talking about education reform."

Kern believes this opportunity will allow direct influence over programs that will inspire our next generation to explore. "I believe insight is key when rolling out new programs, initiatives, or training. How will it be received at the teacher, state, and national level is key to successfully gaining classroom access. Whatever you are doing, it must support the national policy conversation in education, at all levels."

For the avid bike rider, Kern's new position in Maryland puts an end to the daily 20-mile bike commute from Old Town Alexandria, Virginia to the Department of Education in Washington, D.C. "On the weekends I cram to make up those miles." In addition to traveling with wife Monica, Kern enjoys singing in the Metropolitan Chorus and bargain hunting at second-hand stores. ■

Photo credit: NASA/Goddard/Bill Hrybyk